AMC-400 Series

Digital Transmitter with Smart Sensor

USER MANUAL

IMPORTANT:

Please read the installation and operating instructions completely and carefully before starting.

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1 GENERAL INFORMATION

1.1 WARRANTY

The AMC-400 Digital Transmitter is warranted against defects in material and workmanship for a period of two years from date of delivery. Maintenance items are not warranted. During the warranty period, *The Armstrong Monitoring Corporation* will repair or replace components that prove to be defective in the opinion of AMC. Any equipment deemed to be defective by the user should be returned to *The Armstrong Monitoring Corporation* for evaluation (see product return below). Site visits by Armstrong personnel, to evaluate/repair equipment, are not covered by this warranty unless covered under site contract. AMC is not liable for auxiliary interfaced equipment, nor for consequential damage. This warranty shall not apply to any product, which has been modified in any way, which has been repaired by any other party other than a qualified technician or authorized AMC representative, or when failure is due to misuse or conditions of use.
Note: extended warranty mail in calibration programs is available (please call 1-800-465-5777) or through contacts at www.armstrongmonitoring.com

1.2 LIABILITY

All AMC products must be installed and maintained according to instructions. Only qualified personnel should install and maintain the equipment.

AMC shall have no liability arising from auxiliary interfaced equipment, for consequential damage, or the installation and operation of this equipment. AMC shall have no liability for labor or freight costs, or any other costs or charges in excess of the amount of the invoice for the products.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SPECIFICALLY THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF.

WARNING

CHECK TO ASSURE THE WORKING AREA IS FREE FROM HAZARDS DURING INSTALLATION OR WHEN PERFORMING MAINTENANCE, AND USE PROPER PRECAUTIONS.

1.3 PRODUCT RETURN

All products returned for warranty or service should be shipped by prepaid freight and will be accepted only with RMA or repair number issued by AMC. All products returned to the client will be shipped by freight collect.

1.4 CONTACT INFORMATION

For information please call 1-800-465-5777 or through contacts at www.armstrongmonitoring.com or through email directly at support@armstrongmonitoring.com.

1.5 MODIFICATIONS AND SUBSTITUTIONS

Due to an ongoing development program, AMC reserves the right to substitute components and change specifications at any time without incurring any obligations

1.6 ORGANIZATION OF THE MANUAL

This manual provides the following major sections:

1. **PRODUCT DESCRIPTION - This section illustrates the product features with a brief description.**
2. **INSTALLATION – This section illustrates the installation of the product, describing the mounting, wiring for power and communication.**
3. **OPERATION AND CALIBRATION – This section discusses in detail the operation and procedure for operating and calibrating this product.**
4. **MAINTENANCE – This section list the maintenance schedule and options associated with this product.**

1.7 GLOSSARY

Alarm	**Alarm is an audible, visual, or physical presentation designed to warn the instrument user that a specific level of a dangerous gas/vapor concentration has been reached or exceeded.**
Calibration	**Calibration is the procedure used to adjust the instrument for proper response.**
Calibration Gas	**Calibration Gas is a gas of known concentration(s) used to set the instrument span or alarm level(s).**
DT	**Digital Transmitter**
Gas Concentration	**Gas Concentration is measured:** • **PPM**
PPM	**Parts Per Million (1% volume = 10,000PPM)**
Percent by volume	**Concentration of gas in a mixture expressed as a percentage of total volume.**
RS-485	**Superseded with EIA-485 or TIA-485**
Span	**Full range of a sensor i.e. a CO sensor with a full scale of 0-100 PPM has a 100 PPM span.**
SS2	**Smart Sensor 2**
T90	**Response Time in seconds to achieve 90% gas concentration reading. This a typical calibration point that allows for sensor aging, but tends to be less accurate than a T99 calibration,**
T99	**Response Time in seconds to achieve 99% gas concentration reading. This is a more accurate calibration point.**
Zero Buffering	**Zero buffering is transmitter function which forces the gas concentration reading to zero when sensor is exposed to low concentration of a gas. The zero buffers is provided in the sensor specification.**
Zero Gas	**Zero gas is gas with no concentration. Clean air is an excellent source for zero calibration. A known gas concentration can be entered during zero calibration.**

2 PRODUCT INFORMATION

The AMC-400 Series Digital Transmitter with Smart Sensor is a two part assembly; Transmitter and Smart Sensor module. Both modules have Microcontroller (MCUs) to manage and communicate the information in a digital formal. The Transmitter communicates with a monitor (i.e. AMC-1DAX) and carries a Smart Sensor module. The monitor and transmitter communicate to each other over RS-485 using MODBUS/RTU. The smart sensor acquires data from an electrochemical gas sensor and communicates its gas concentration to the transmitter. The smart sensor module is designed for modular Exchange Program for calibration purpose.

Note:

All Armstrong Monitoring systems must be installed and maintained according to instructions to assure proper operation. Only qualified personnel should install and maintain the equipment. For exchange, re-calibration or extended warranty programs information please call 1-800-465-5777 or through contacts at www.armstrongmonitoring.com

2.1.1 TRANSMITTER MODULE SPECIFICATION

Transmitter Order Number……... ……...	**AMC-400A**
Power Supply Requirement……..	**Two Wire optional Shield 12 to 24 VDC/AC**
Warranty……	**2 Years**
Operating Temperature ……	**-20° to 50° C**
Operating Pressure ……...	**0.9 to 1.1 atm**
Relative Humidity ……..	**15 to 90% RH, non-condensing**
Signaling……...	**Two Wire with Shield Modbus RTU over RS-485 9600 Baud, 8bit Even Parity.**

2.1.2 SENSOR MODULE(S) SPECIFICATION

Gas Type……...	**CARBON MONOXIDE (CO)**
Sensor Order Number……	**AMC-91A0F**
Sensor Height Above Finished Floor	**4-6 Feet**

Sensor Life……..……	**6 Years**
Sensor Warranty……	**3 Years**
Span Gas ……..……	**0-100ppm**
Zero Buffering of Display	**<8ppm**
Calibration Adapter Part Number……	**AMC-C1-FK1**
Gas Flow Rate	**.5L/min.**

Gas Type……...	**NITROGEN DIOXIDE (NO_2)**
Sensor Order Number……	**AMC-98AHC**
Sensor Height Above Finished Floor	**4-6 Feet**
Sensor Life……..……	**2 Years**
Sensor Warranty……	**1 Years**
Span Gas ……..……	**0-10.0ppm**
Zero Buffering of Display	**<0.8ppm**
Calibration Adapter Part Number……	**AMC-C1-FK2**
Gas Flow Rate	**.5L/min.**

3 PRODUCT DESCRIPTION

The AMC-400 Digital Transmitter is designed to provide continuous, reliable monitoring of ambient air for the target gas listed in the SENSOR MODULE(S) SPECIFICATION. This unit is hot pluggable and powered by either AC or DC power source and provides digital representation of the gas concentration detected. A digital gas concentration display is provided, which may be configured to remain blank. Each sensor/transmitter unit is factory calibrated, and is ready for field installation and operation.

Each sensor module features alarm indicators and connection terminal blocks, as listed and described below.

3.1 OVERVIEW

The AMC-400 Digital Transmitter consists of three main components;

- **PVC Enclosure,**
- **Lid Assembly,**
- **Smart Sensor 2 Assembly.**

The following three drawings are provided to briefly describe these components.

3.2 FRONT LID OVERVIEW

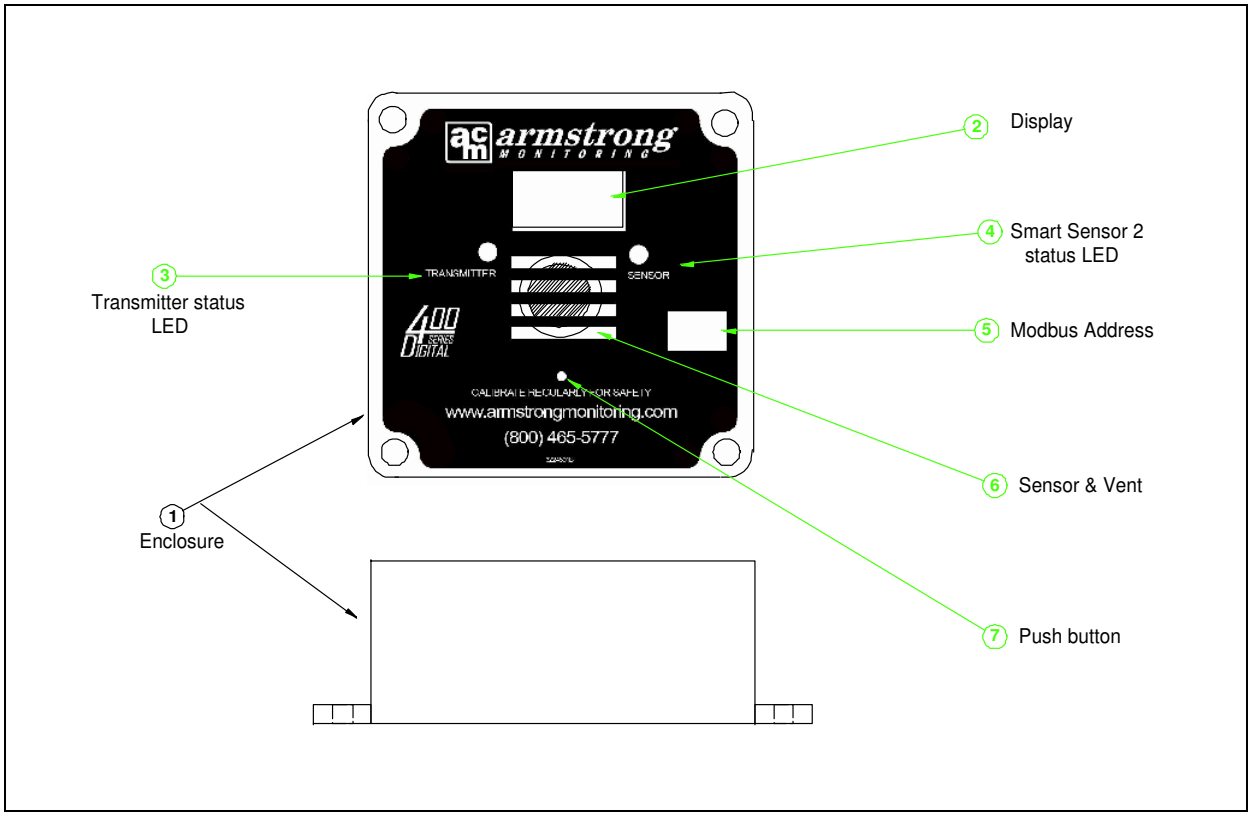


Figure 3-1 Front Lid View

1. Enclosure:	**Enclosure and Lid Assembly, PVC 4"x4" Wall mount with mount points. Enclosure Lid attaches with four screws.**
2. Digital Display:	**Displays gas concentration & Status information, 3 Digit User Interface for configuration**
3. Transmitter Status LED:	**Red/Green LED Indicates status of Transmitter.**
4. Smart Sensor 2 Status LED:	**Red/Green LED Indicates status of integral Smart Sensor.**
5. MODBUS Address	**This is a write on area matching the MODBUS node ID (Address). The indication here may be factory set and can be changed as needed.**
6. Sensor & Vent	**This vent allows target gas to flow into the sensor. The vent is also used for gas calibration.**
7. Pushbutton:	**Momentary On/Off Pushbutton User Interface for Configuration.**

3.3 REAR LID OVERVIEW

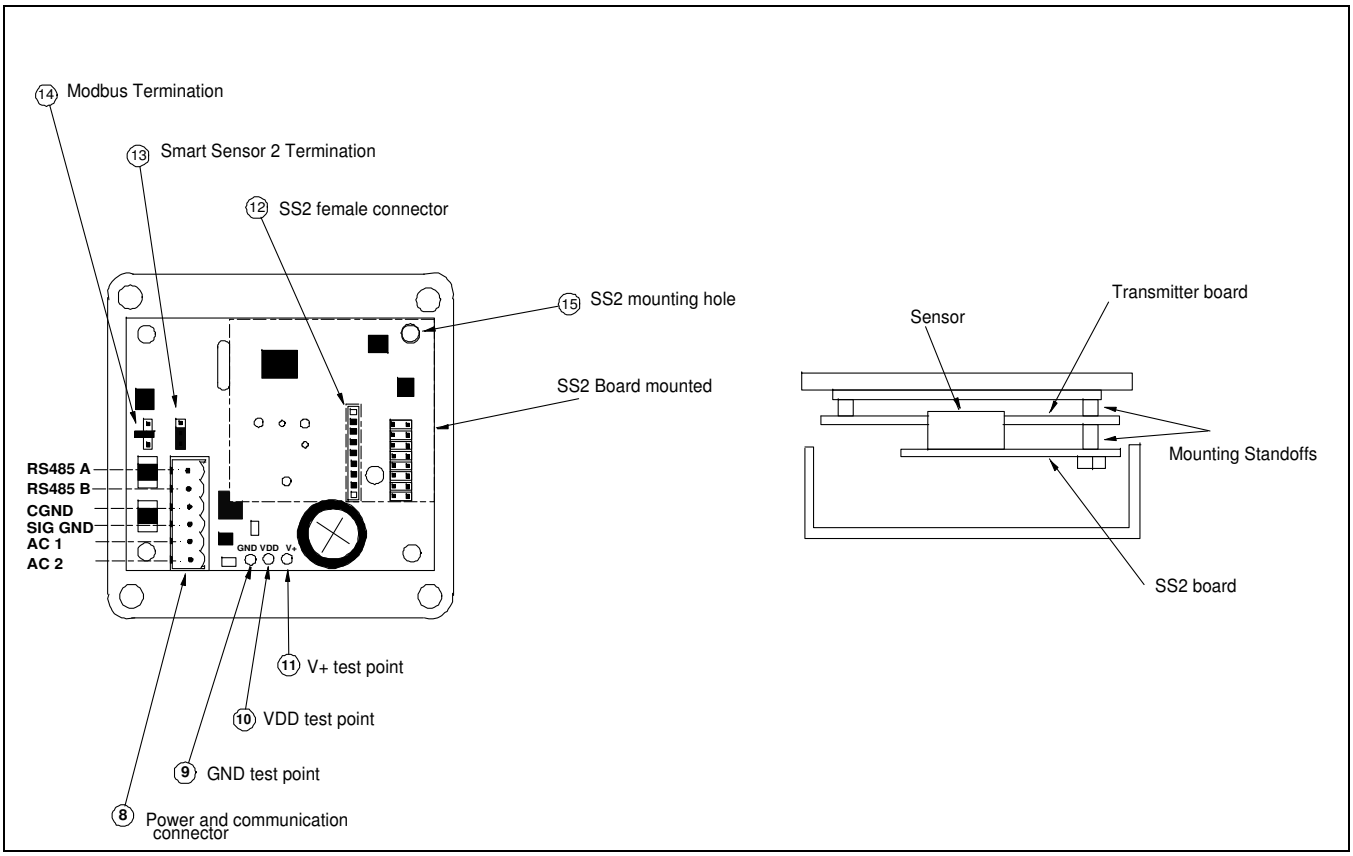


Figure 3-2 Rear Lid View

Note:

When mounting the Smart Sensor module, it is possible for its male header pins to miss the receptacle of the Digital transmitter completely.

Warning:

Care must be taken when connecting services to Power and Communication Connector. Avoid using SIG GND for powering. Cable shield(s) are to be connected to CGND. Mixing power and communication connections can cause permanent damage. Consistent polarity of RS-485 wire is required throughout network for proper system operation.

8. Power and Communication Connector:	**This 6 pin male plug connector contains both power and communication network connection points. The power is normally 24VDC and the communication network is MODBUS over RS-485.**
9. GND Test Point:	**This GND Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the signal reference point for the digital transmitter control logic.**
10. VDD Test Point:	**This VDD Test Point is to be used by service technicians only. It is the digital transmitter control logic supply voltage and must be 5+-5% Volts DC.**
11. V+ Test Point:	**This V+ Test Point is to be used by service technicians only. It is the digital transmitter rectified unregulated power input and must be 8-35 Volts DC.**
12. SS2 Female Connector:	**This 7 pin connector mates with the Smart Sensor 2 Assembly male connector. This connector carries the power and communication for Smart Sensor 2.**
13. Smart Sensor 2 Termination:	**Default position: AC Termination (Pins 1-2). This termination allows AC or DC Termination for the Smart Sensor II RS-485 signaling.**
14. MODBUS Termination:	**Default position: No Termination (Pin 2). This termination allows AC or DC Termination for the MODBUS RS-485 signaling. Use AC Termination (Pin 1-2) when transmitter is an end point on bus.**
15. SS2 Mounting Hole:	**This mounting hole contains two standoffs to support the Smart Sensor II Assembly. One standoff is a stud the other is nylon press-fit.**

3.4 SMART SENSOR 2 OVERVIEW

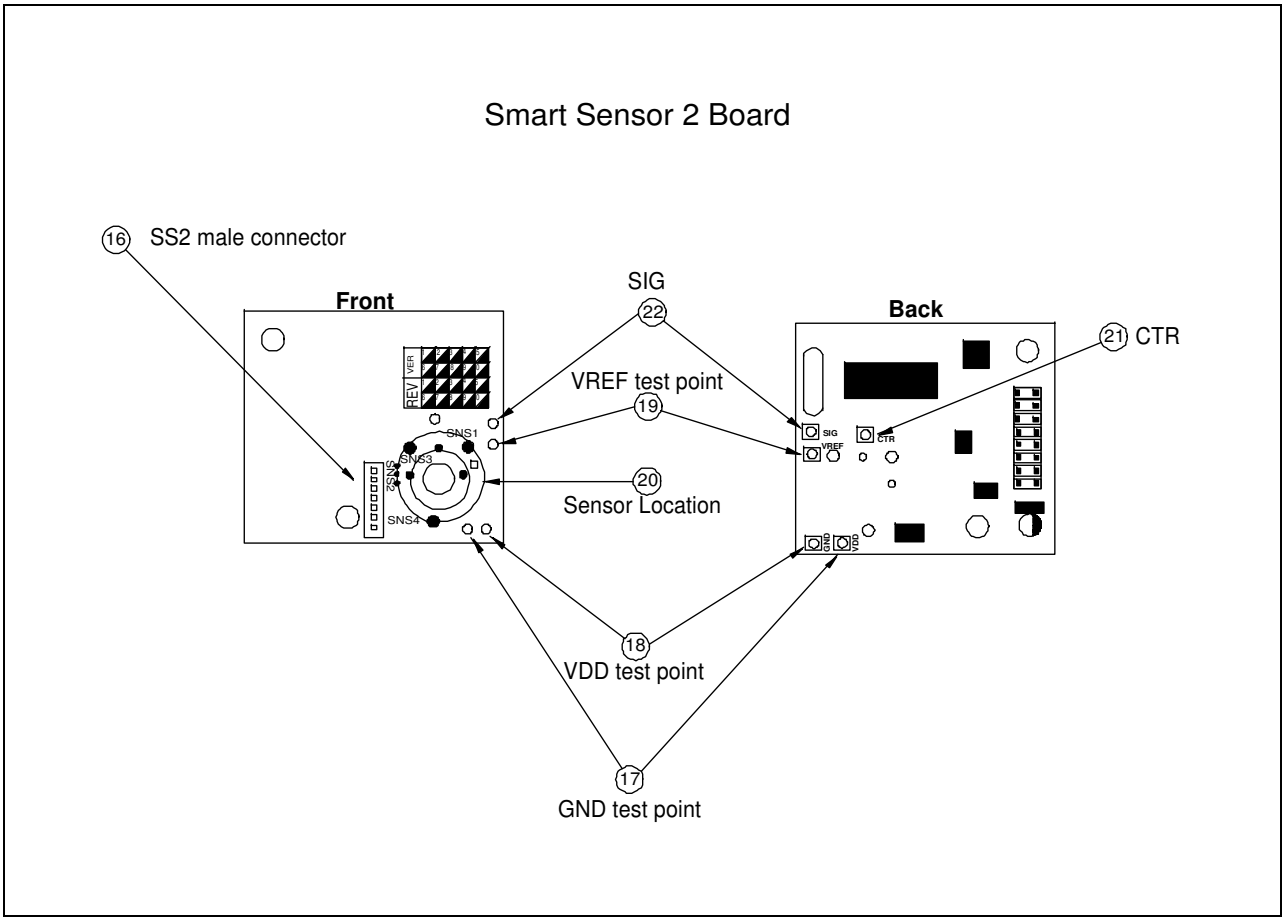


Figure 3-3 Smart Sensor 2 View

16. SS2 Male Connector: **This 7 pin connector mates with the Digital Transmitter Assembly female connector. This connector carries the power and communication.**

17. GND Test Point: **This GND Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the signal reference point for the smart sensor 2 control logic.**

18. VDD Test Point: **This VDD Test Point is to be used by service technicians only. It is the smart sensor 2 control logic supply voltage and must be 3.42 to 3.78 Volts DC.**

19. VREF Test Point:	**This VREF Test Point is to be used by service technicians only. It is the potentiostat sensor reference and must be 1.8 Volts DC.**
20. Sensor:	**This component may be a variety of 2 or 3 pin electrochemical sensors. This component is securely fastened with glue to Smart Sensor 2 Assembly.**
21. CTR Test Point:	**This CTR Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the potentiostat counter output used by a 3 pin electrochemical sensor. Under ideal operation zero gas situation it is normally 1.8 Volts DC VREF.**
22. SIG Test Point:	**This Sig Test Point is to be used by service technicians only with appropriate instrumentation such as a voltmeter. It is the potentiostat sensor output used. Under normal operation zero gas situation it tracks the 1.8 Volts DC VREF. When CO gas is applied this SIG Test Point increases toward 3.6 Volts DC. When NO2 gas is applied this SIG Test Point decreases towards 0 Volts DC.**

4 INSTALLATION

The installation of the AMC-400 Digital Transmitter is very important as the operational quality is a direct result of the quality of the installation. The following sections provide guidelines for installation; location and mounting, wiring, and cable selection.

4.1 LOCATION AND MOUNTING

Mount the AMC-400 Digital Transmitter sensor/transmitter on a solid, non-vibrating surface or structure in an area where the ambient concentration of gas is not directly affected by the presence of clean air supply, ventilation systems, or blockage by surrounding articles and sources of interference gases. Please, refer to local codes for sensor/transmitter installation information. The installer is required to provide any mounting hardware that may be required. The AMC-400 Digital Transmitter sensor/transmitter circuit board(s) with sensor is removable from the enclosure for ease of installation. The recommended mounting height is specified in the SENSOR MODULE(S) SPECIFICATION. The conduit entry is from bottom of box to avoid moisture flow into box through conduit.

Notes:

Mount enclosure with the sensor located as shown is Figure 4-1. This will ensure correct orientation.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot powering of the Smart Sensor 2 unit. Please completely disconnect power from Digital Transmitter before replacing Smart Sensor 2 assembly.

Installing conduit from top of box will allow moisture from condensation to drip down into circuit assembly. Damage caused by this type of installation will void warranty.

Caution:

Conduit entry is from the bottom of enclosure to avoid damage to electronic components from condensation build-up in the conduit.

4.1.1 CONDUIT MOUNTING

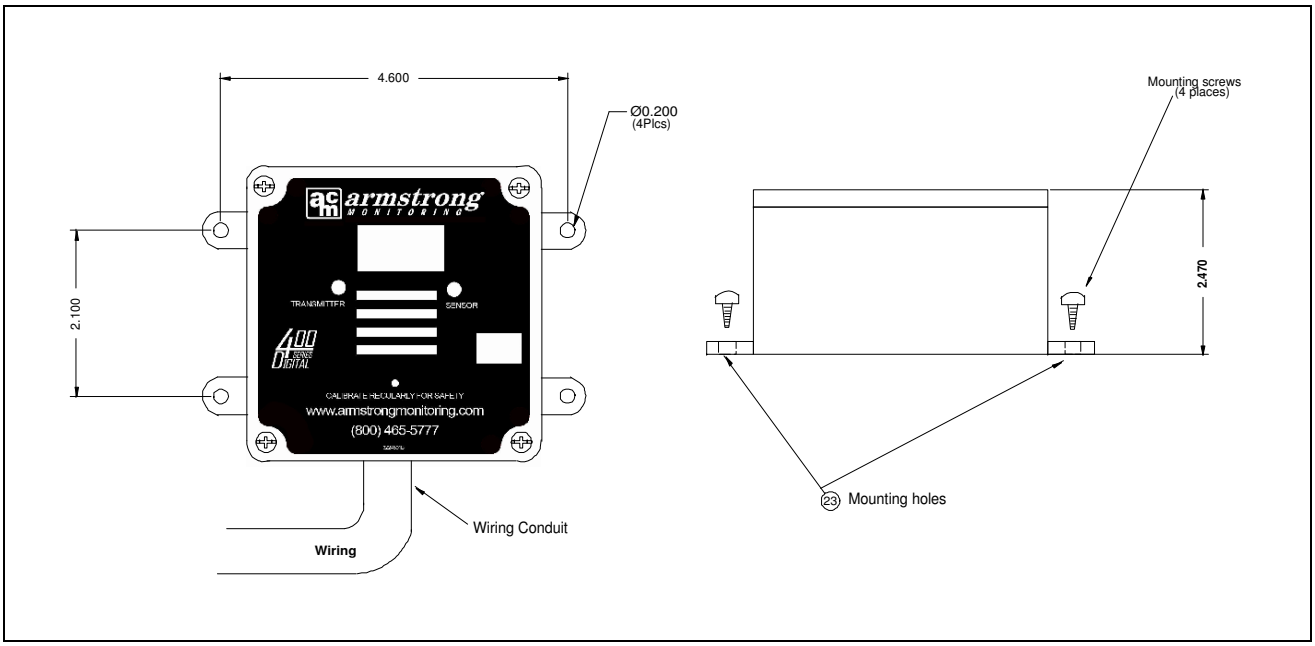


Figure 4-1 Conduit Mounting

23. Mounting Holes: **Wall mounts with 4 holes.**

4.2 WIRING

The AMC-400 Digital Transmitter employs a four wire system which has two main wiring systems: the monitor communication (two wires) and power supply wiring (two wires).

A two conductor, shielded cable is used to connect the RS-485 signals from the AMC-400 Digital Transmitter to the monitor.

A two conductor, shielded cable is recommended to connect the power from the AMC-400 Digital Transmitter to the power supply. Shielded cable is optional for power supply wiring.

For best signal transmission and maximum noise rejection, it is recommended to connect the cable shields to chassis ground at the monitor.

Below are example electrical wiring diagrams for an application where monitor supplies both power and communication.

Warning:

Installing monitor communication without shield will produce unreliable system wide failure. Armstrong Monitoring Corporation will not support this type of installation.

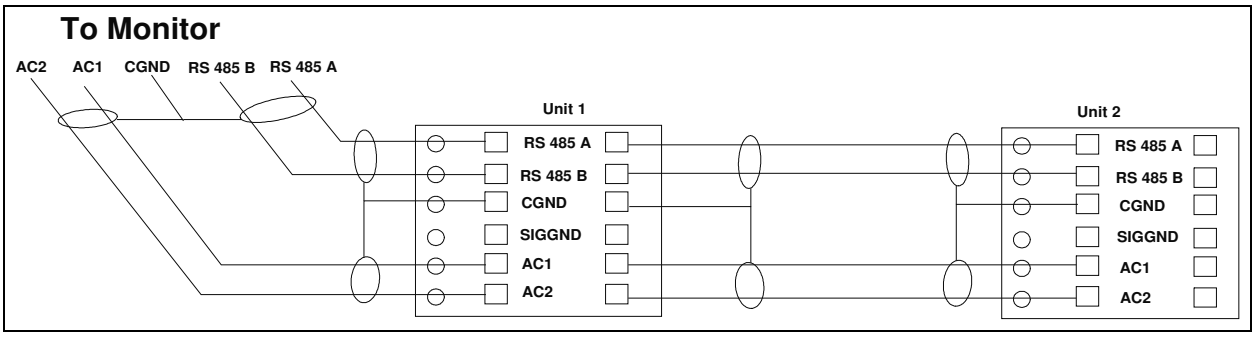


Figure 4-2 Example of Electrical Wiring of Digital Transmitter(s)

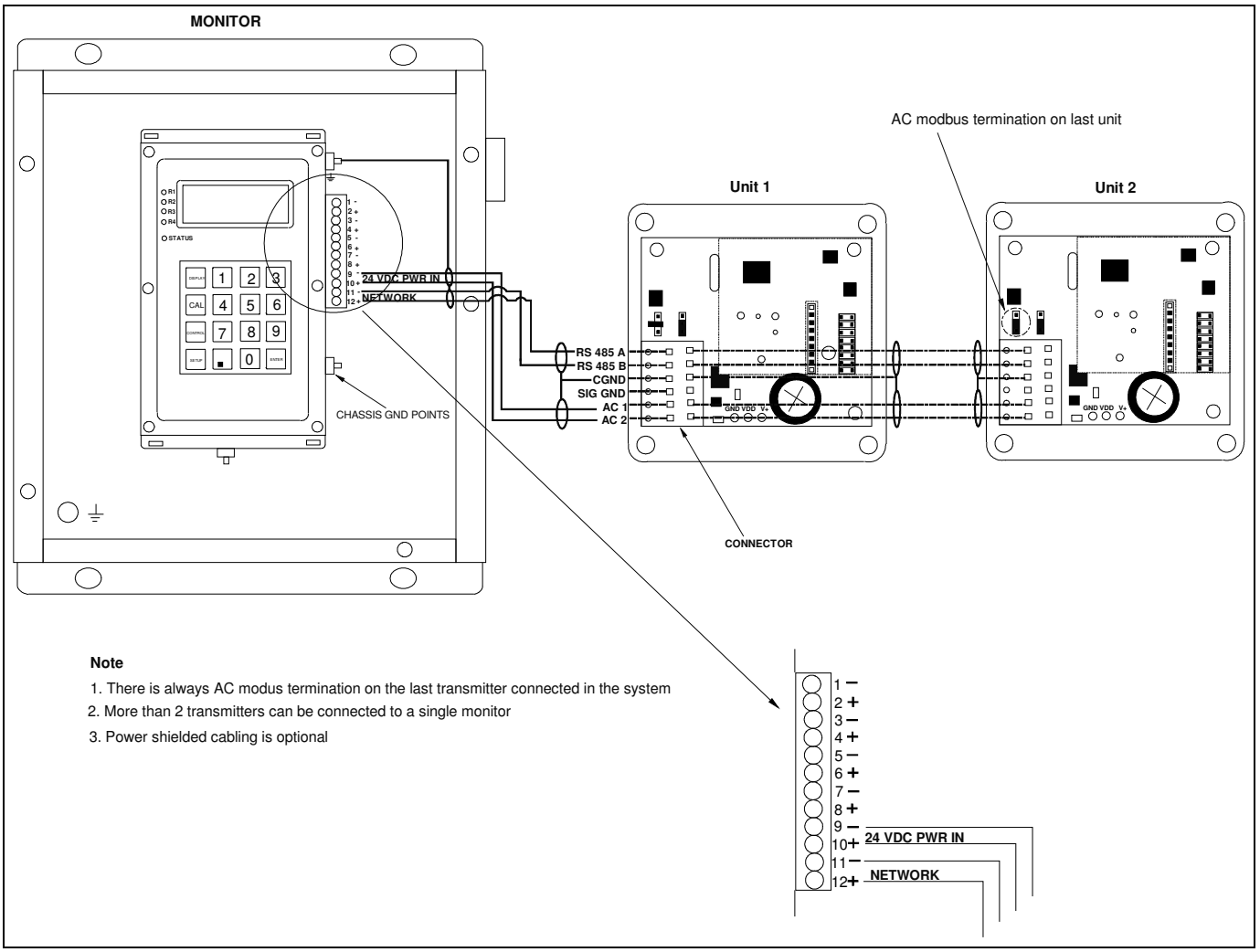


Figure 4-3 Example of Connections to a AMC-1DAX Monitor

Warning:

Care must be taken when connecting services to Power and Communication Connector. Avoid using SIG GND for powering. Cable shield(s) are to be connected to CGND. Mixing power and communication connections can cause permanent damage. Consistent polarity of RS-485 wire is required throughout network for proper system operation.

4.2.1.1 POWER SUPPLY

The AMC-400 Digital Transmitter assembly is to be powered by the AMC-1DAX monitor Power Supply. An AMC-400 Digital Transmitter is powered through a cable on AC1 and AC2 connections as shown in the REAR LID OVERVIEW; item 8 Power and Communication Connector:.
The rectified unregulated V+ Test Point: voltage must be between 8 and 42 Volts DC. The shield of the cable should be connected to chassis ground on CGND at the monitor power supply and the AMC-400 Digital Transmitter.

Caution:

Care must be taken when installing to ensure that all Digital Transmitters are connected with the same power supply polarity across the network. Digital Transmitter AC2 should be connected to + power terminal and Digital Transmitter AC2 should be connected to – power terminal. Using SIG GND for powering should be avoided.

The recommend power cable should be a two wire conductor plus shield cable with #18 AWG. The cable length must not exceed a distance that prevents the Digital Transmitter from obtaining a minimum voltage of 8 Volts DC at V+ Test Point.

4.2.1.2 COMMUNICATION

The AMC-400 Digital Transmitter assembly is to be controlled by the AMC-1DAX monitor or other MODBUS masters. The AMC-1DAC has the possibility of managing 80 nodes on the network. All nodes are connected to same two communication signals; RS485A and RS485B. The AMC-400 Digital Transmitter communicates through a cable connection on RS485A and RS485B as shown in the REAR LID OVERVIEW; item 8 Power and Communication Connector:

Caution:

Care must be taken when installing to ensure that all Digital Transmitters are connected with the same MODBUS polarity across the network. Digital Transmitter RS485A should be connected to + network terminal and Digital Transmitter RS485B should be connected to – network terminal. Using SIG GND for powering should be avoided.

The recommend cable should be a two wire twisted pair conductor plus shield cable and has a characteristic impedance of 120ohms.

The total cable length for the entire network should not exceed 1000 M. Please refer to MODBUS OVER SERIAL LINE SPECIFICATION AND IMPLEMENTATION GUIDE V1.0 27/44

This cable should be a two wire twisted pair conductor shielded cable. The shield of the cable should be connected to chassis ground on CGND at the monitor and the AMC-400 Digital Transmitter.

MODBUS AC termination is required for last unit of bus; please refer to REAR LID OVERVIEW MODBUS Termination; item #14 for details.

5 OPERATION AND CALIBRATION

This section describes how the functionalities of the AMC-400 Digital Transmitter are operated and performed. Please consult the operation and initial configuration chapters below before attempting to operated the AMC-400 Digital Transmitter.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot powering of the Smart Sensor 2 unit. Please completely disconnect power from Digital Transmitter before replacing Smart Sensor 2 assembly.

5.1 OPERATION

5.1.1 TRANSMITTER JUMPER

The Digital Transmitter has two straps; Smart Sensor 2 Termination and MODBUS Termination. Please refer to REAR LID OVERVIEW for details.

5.1.2 TRANSMITTER AND SMART SENSOR 2

The AMC-400 Digital Transmitter sensor/transmitter is factory calibrated for the gas listed in the Product Information (Section 2) at the beginning of this manual. The sensor/transmitter should not require re-calibration when first installed and powered up, but a test for correct sequence of operation is recommended after a stabilization period of five minutes. Activity on the LED(s) indicates that the board is powered on.

At power up, the display runs through the following sequence:

1. **Indicates the software/Hardware versions and performs a self test**
2. **Display sensor stabilization status**
3. **Displays the gas type**
4. **Displays the detected level**

Note:

The transmitter will experience a reboot and repeat the above sequence if no MODBUS traffic is detected for a period of five minutes. Additionally a failed transmitter will reboot after one to two minutes.

Additionally the AMC-400 Digital Transmitter can insert other sensor status between gas type and gas concentration. This following sensor status is available:

Sensor Status	*Definition*	*Action*
"*PUP*"	**Sensor in stabilization Power Up Period**	**Wait up to 5 minutes for sensor to stabilize.**
"*CAL*"	**Sensor needs CALibration**	**Consult CALIBRATION and MAINTENANCE sections in this manual.**
"*OFL*"	**Sensor in Over Flow out of range state. Gas concentration is exceeding full span range of sensor.**	**Consult AMC for appropriate Smart Sensor type and use. It is not recommended to operate Smart Sensor outside specified operating limits. Gas concentration is this mode may be at hazardous levels.**
"*EOL*"	**Sensor has reached End Of Life**	**Contact AMC for replacement. Sensor operated beyond EOL may provide erroneous readings.**

In near zero gas and after the stabilization period, the transmitter will send accurate gas concentration MODBUS packets to the monitor or controller. Although the electrochemical sensors are very selective, there are some interference gases which can cause a response from the sensor. In the case of a large response, please check background gas potential or the possibility of an interference gas being present.

Caution:

When the gas concentration exceeds the full scale range, the display will alternate between the reading value and the letters "*OFL*" for overflow. Refer to 2.1.2 SENSOR MODULE(S) SPECIFICATION for SPAN, consult AMC for alternative Smart Sensor 2 types. It is not recommended to operate Smart Sensor outside specified operating SPAN. Gas concentration is this mode may be at hazardous levels.

The front panel view below shows the four areas of user interface; Pushbutton, Display, TX Status, and Sensor Status. These user interfaces are briefly described below and referenced in more detail under the initial configuration and calibration sub-sections.

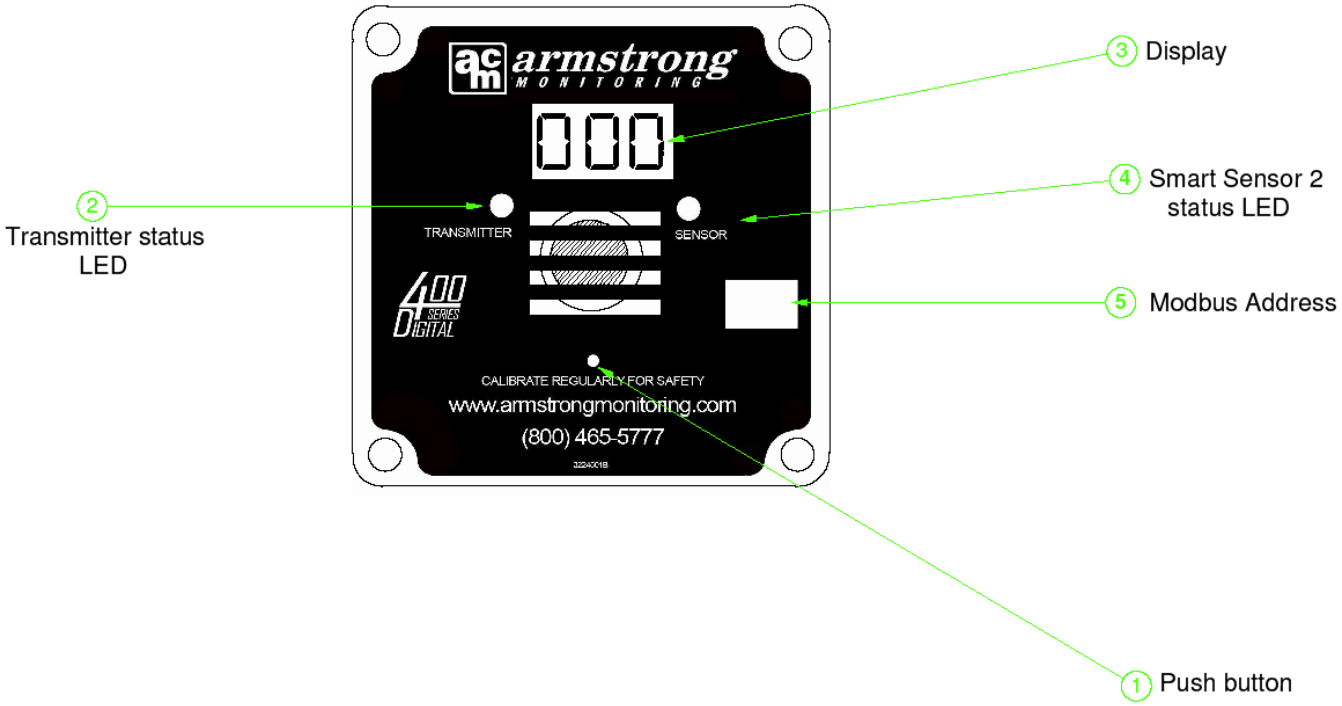


Figure 5-1 Front Panel User Interface

Note:

The Pushbutton (reference point 1) is positioned behind the front panel and requires a small TOOL SCREWDRVR SLOT ESD 1.5MM, Wiha 27215 to access it through a small hole.

The Pushbutton allows a user to navigate through configuration menu. The pushbutton has two states; short and long button press. Short press is less than two seconds while long press is greater than two seconds. Feedback of the pushbutton state is provided on the display. A short press will display both decimal points, while a long press will display "SEL". As an example the pushbutton must be pressed and held for at least 2 seconds to enter configuration. The display will indicate "SEL" when user has held the pushbutton long enough to enter the configuration menu.

The Display has 3 character positions with two decimal points, each character has 7 segments. The LCD can display numbers and various alphabetic characters. Some alphabetic characters are upper case while others are lower case. In normal operation the display will cycle between the gas concentration and gas type, in configuration the display is used to indicate configuration titles and items. By default the Gas concentration is displayed in PPM and may or may not have a decimal point. The Gas type is displayed in alphanumerical characters as an example "co" indicates Carbon Monoxide and "no2" indicates Nitrogen Dioxide.

The TX Status is a green and red LED to indicate activity of the MODBUS link and transmitter health and state. As an example a slow blinking green TX status indicates

healthy MODBUS activity detected, while a period of fast blinking red TX status can indicate a momentary MODBUS fault. Please refer to TRANSMITTER STATUS LED for further details.

The Sensor Status is a green and red LED to indicate activity of the Smart Sensor link and Smart Sensor health and state. As an example a slow blinking green Sensor status indicate healthy activity detected, while a period of fast blinking red Sensor status can indicate a momentary sensor bus fault. Please refer to SENSOR STATUS LED for further details.

Note:

AMC-400 Digital Transmitter LED will appear to blink slow green even though it is not being accessed by a monitor. This is the case when MODBUS address is not properly configured. Use 5.3.4 GAS TEST AND SERVICE MODES to verify proper configuration this will allow gas concentration to be observed at the monitor or controller.

5.1.3 TRANSMITTER STATUS LED

The Transmitter Status LED under normal operation should be slow blinking green indication. Slow blinking green indicates MODBUS communication detected and no transmitter faults. Numerous transmitter faults can occur under various situations and is indicated with momentary fast blinking red indication. A fast blinking green indicated no MODBUS communication present and no transmitter faults.

Note:

AMC-400 Digital Transmitter Status LED will momentarily fast blink red under a minor transmitter fault situation, such as erroneous MODBUS packet. Consult AMC for service if minor transmitter fault persists.

Below is the possible Transmitter Status LED:

Transmitter LED State	*Definition*	*Action*
Slow Blinking Red	Transmitter initializing.	Wait for initialization to complete.
Slow Blinking Green	Transmitter is healthy.	No action required.
Fast Blinking Green	Transmitter is healthy, but no MODBUS communication detected.	Check if monitor is MODBUS connected and not in setup.
Slow Blinking Green/Red	Transmitter is in configuration mode.	Complete configuration and exit.
Fast Blinking Green/Red	Transmitter is in gassing state of calibration.	Complete calibration and exit.
Fast Blinking Red	Transmitter has experienced a minor fault in the last 10 seconds of operation.	Check if transmitter and/or other system components have valid operating limits (i.e. connections, power supply, temperature, and MODBUS addressing). Consult AMC for service if status persists.
Solid or long period Red, Green or Orange	Transmitter has experienced a severe fault.	Wait one to two minutes for unit to enter normal mode. Consult AMC for service if status persists.
LED Extinguished	Transmitter is powered off.	Check transmitter wiring or power supply state. Consult AMC for service if status persists.

5.1.4 TROUBLESHOOTING MODBUS USING THE TRANSMITTER STATUS LED

The Transmitter Status LED indirectly provides a MODBUS monitor function. Using this LED in conjunction with other transmitters can help in diagnostic of MODBUS faults. Here is a list of troubleshooting guidelines of the Transmitter Status LED:

A. If all transmitters blink fast green and the monitor is in operation mode then the MODBUS wiring is likely disconnected at the monitor.
B. If one or more transmitter(s) in a chain are blinking fast green and a unit closer to the monitor is blinking slow green then a MODBUS disconnection point begins after the slow blinking green unit.
C. If a transmitter is blinking fast red and other transmitter units are blinking slow green then check that the MODBUS connections are not reversed on the flashing red unit.
D. If a transmitter blinks slow green, but the monitor indicates "na" for that unit then the transmitter unit needs its MODBUS address to be assigned.
E. If two transmitter units blink slow green, but all other transmitter units indicate fast blinking red, then the two slow blinking green transmitter units have the same MODBUS address.
F. If the monitor appears to be operating well with one or more transmitters, but transmitter unit(s) have fast blinking red from time to time, then MODBUS signal degradation is present. Check that the both MODBUS signals wires and shield are properly connected.

5.1.5 SENSOR STATUS LED

The Sensor LED Status under normal operation has a slow blinking green indication. Slow blinking green indicates good Smart Sensor communication detected and no sensor faults. Numerous sensor faults can occur under various situations and is indicated with momentary fast blinking red indication.

Caution:

Sensor LED status will momentarily fast blink red under a minor sensor fault situation, such as a packet error. Consult AMC for service if minor sensor fault persists.

Below is the possible Sensor LED Status:

Sensor LED State	*Definition*	*Action*
Slow Blinking Red	Smart Sensor initializing.	Wait for initialization to complete.
Slow Blinking Green	Smart Sensor is healthy.	No action required.
Fast Blinking Green	Smart Sensor is healthy, but no communication detected.	Check if Smart Sensor is properly connected to TX.
Slow Blinking Green/Red	Smart Sensor is in configuration mode.	Complete configuration and exit.
Fast Blinking Green/Red	Smart Sensor is in gassing state of calibration.	Complete calibration and exit.
Blinking Red for 10seconds every minute of Slow Blinking Green	Smart Sensor requires services either calibration or has reached end of life. DT display will complement this with "CAL" or "EOL" indication.	Consult calibration section in this manual or contact AMC. It is not recommended to operate Smart Sensor after end of life or when calibration is needed. Sensor operated beyond CAL or EOL may provide erroneous readings.
Fast Blinking Red	Smart Sensor has experienced a minor fault in the last 10 seconds of operation.	Check if Smart Sensor has valid operating limits (i.e. power supply, temperature, and Smart Sensor addressing). Consult AMC for service if status persists.
Solid or long period Red, Green or Orange	Smart Sensor has experienced a severe fault.	Wait one to two minutes for unit to enter normal mode. Consult AMC for service if status persists.
LED Extinguished	Smart Sensor is powered off.	Check Smart Sensor wiring or power supply state. Consult AMC for service if status persists.

Note:

The Smart Sensor will experience a reboot and enter initialization state (slow blinking RED Sensor Status LED) if no transmitter requests are detected for a period of five minutes. Additionally a failed Smart Sensor will reboot after one to two minutes.

5.2 INITIAL CONFIGURATION

Initial installation requires a unique MODBUS address to be configured. The current MODBUS address may be pre-configure and labeled on the front panel in small box (see front panel view item 5). User can change the MODBUS address by entering configuration. MODBUS addresses must be in the range of 1-247. Please refer to Appendix for menu flow diagrams and guide.

Caution:

An invalid MODBUS address may cause other devices to malfunction. It is important to carefully map out MODBUS addresses.

Note:

AMC-400 Digital Transmitter will automatically exit current level of configuration after 1 minute of inactivity without change. This can be useful when user is lost or unsure of current modification.

The AMC-400 Digital Transmitter configuration is divided into 6 areas;

- **MODBUS Configuration**
- **Smart Sensor Configuration**
- **Digital Transmitter Configuration**
- **Zero Calibration**
- **Span Calibration**
- **Service Modes**

1. **To enter configuration press and hold the pushbutton for 2 seconds or more until the display shows "SEL". When the pushbutton is released the Configuration Menu title "-CF" will be displayed.**

2. **The possible items in configuration are:**

   "-CF" Configuration Title and Exit Point
   "A01" MODBUS Configuration
   "A02" Smart Sensor Configuration
   "A03" Digital Transmitter Configuration
   "A04" Zero Calibration
   "A05" Span Calibration
   "A06" Service Modes

3. **At this point the user can immediately exit configuration by push and holding the pushbutton for >2 seconds and releasing. Alternatively the user can scroll through the above 6 choices by short pressing the pushbutton (<2seconds). The list is circular in nature.**

Note:

Configuration titles with a negative sign are exit points. Just press and hold the

pushbutton for >2seconds and release to get to the previous level. Scrolling with quick button presses will normally cycle you to an exit point without change.

4. **To enter MODBUS Configuration the user must press and hold the pushbutton for >2 seconds and release at the item A01. The MODBUS title "-FB" will be displayed.**

5. **To configure the MODBUS address short press to the item "F01" and press and hold for >2seconds and release to enter sub-item. At this point the current MODBUS address will be displayed; a short press returns you back to "F01" which can lead you to an exit point.**

6. **To modify the MODBUS address press and hold for >2seconds and release to edit the first digit of the address. The least significant digit can now be changed, scroll quickly with short presses and cycle through the number choices from the current number to 9 and then back to 0. Press and hold >2seconds and release to move to next most significant digit position. Repeat sequence for second digit and third digit. When the MODBUS address is displayed use a short press to return to "F01".**

7. **Use short presses to scroll to item "-FB" and push and hold the pushbutton for >2 seconds and release to return to A01. Use short presses to scroll to item A03.**

8. **To enter Digital Transmitter Configuration the user must push and hold for >2seconds and release at item A03. The title "-du" will be displayed. Scroll through to d01, push and hold for >2seconds and release to enable LCD blanking. LCD will blank after 1 minute of pushbutton inactivity, pressing the pushbutton restores display. Alternatively scroll to d02, push and hold for >2seconds and release to disable LCD blanking. Or scroll to d03, push and hold for >2seconds and release to enter Digital Transmitter location label. Location labeling allows a unique 3 character string to be assigned to Digital Transmitter. This procedure is similar to entering the MODBUS address, but the choices are alphanumeric.**

Note:

Currently location label is not required by a monitor or controller and can be used as needed to store and retain user information.

9. **Items A04 to A06 can be skipped for initial configuration.**

5.3 CALIBRATION

This calibration procedure is applicable for all versions of the AMC-400 Digital Transmitter.

Every AMC-400 Digital Transmitter sensor/transmitter is factory calibrated, so each unit is to be ready for operation after installation and a 5 minute stabilization time.

The AMC-400 Digital Transmitter and Smart Sensors are equipped with Calibration and End of Life indicators. When calibration or sensor End of Life has occurred the display will interleave "CAL" or "EOL" respectively during normal gas concentration updates.

Subsequent calibration is required as a part of regular maintenance, and when replacing the sensor. See the Maintenance section of this manual for the recommended calibration schedule.

Note:

When the gas sensor needs calibration or has reached end of life the display will alternate between the reading value and the letters "CAL" or "EOL".

Warning:

When performing calibration the results are not saved in Smart Sensor until successful Span procedure has been completed. Powering off unit after Zero procedure and before completing a successful Span procedure will result in calibration information being lost. Also failed Span procedure due to user abort or procedure limit checking leaves the unit with unstable calibration information. It is important to complete a successful SPAN procedure for unit to function properly.

Caution:

- Only qualified personnel should perform the actual calibration.
- Users new to gas calibration are advised to consult with Armstrong Monitoring

The Armstrong Monitoring Corporation offers the following calibration plans:

1. **Factory pre-calibrated exchange replacement smart sensor units**
2. **On site installation by Armstrong Monitoring**
3. **On site calibration by Armstrong Monitoring**
4. **Training by Armstrong Monitoring for end users**

For additional details please refer to CONTACT INFORMATION.

5.3.1 REQUIRED EQUIPMENT; EXCHANGE PROGRAM

For qualified personnel, the following is a recommended list of equipment required.

- **5/16 Nut driver and Philips and Roberson screw driver set**
- **TOOL SCREWDRVR SLOT ESD 1.5MM, Wiha 27215.**

To replace Smart Sensor 2 with pre-calibrated unit, first completely remove power from Digital Transmitter by unplugging Power and Communication Connector as shown in. Use a Nut driver to remove nut that is holding Smart Sensor 2 assembly to Digital Transmitter. Carefully remove and replace Smart Sensor 2 assembly attached to SS2 Female Connector. Replace nut holding Smart Sensor2 to Digital Transmitter with Nut driver.

Warning:

It is possible to improperly insert SS2 Male Pins into SS2 Female connector.

5.3.2 REQUIRED EQUIPMENT; ON-SITE CALIBRATION

For qualified personnel, the following is a recommended list of calibration equipment required.

- **TOOL SCREWDRVR SLOT ESD 1.5MM, Wiha 27215**
- **Calibration kit, please refer to SENSOR MODULE(S) SPECIFICATION.**

5.3.3 CALIBRATION PROCEDURE

The AMC-400 Digital Transmitter is equipped with a calibration feature allowing for one-man calibration at the transmitter location. In most cases it is only Zero and Span adjustments that are made in field calibrations. All Calibration procedures will automatically exit to normal operation without change if left inactive for several minutes. Please refer to Appendix for menu flow diagrams and guide.

Note:

During calibration new gas concentration is not updated to monitor and last gas concentration value will be reported.

Refer to Figure 5-1 Front Panel User Interface to perform the following calibration procedure:

1) **Cover the sides of sensor with a clean cloth or similar to prevent a draft on the sensor. The zero calibration can also be used with a gas concentration for a 2 point calibration procedure (as example 5ppm CO gas could use instead of 0ppm). Perform gassing with a calibration adapter that is firmly inserted into front panel of AMC-400 Digital Transmitter; please refer to 2.1.2 SENSOR MODULE(S) SPECIFICATION for adapter P/N and gas flow rate.**

2) Enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "A04" item with short presses. To begin zero calibration enter the "A04" item with a push and hold >2seconds and release. The zero calibration title "-0C" will be displayed.

3) At this point short press pushbutton to display the Zero Gas Concentration. If the zero gas concentration is to be modified then push and hold for >2seconds and release. The gas concentration can be modified one digit at a time similar to MODBUS address modification in INITIAL CONFIGURATION. Once all digits have been modified another short press will advance procedure to the gassing phase. The AMC-400 Digital transmitter may ignore modifications if the gas concentration entered is not acceptable.

4) At the beginning of zero calibration the AMC-400 Digital Transmitter will display "GaS" "On". Begin gassing at this point to perform a T99 type calibration. The qualified personnel can begin gassing after this point to perform a T90 type calibration by advancing the procedure to measurement phase with a press of the pushbutton.

5) During zero gassing measurement the display will indicate either "Inc" or "dEc" depending of signal level from sensor increasing or decreasing respectively. Also the LCD will display the sensor voltage when the gas concentration is not changing. The measurement phase contains a minimum and maximum gassing period and will automatically complete after gas measurement is stable. Proceed to calibration complete by pressing the pushbutton.

6) During zero calibration complete the AMC-400 Digital Transmitter will display "GaS" "OFF". At this point the qualified personnel must accept or reject this calibration by a push and hold >2seconds or short press respectively. If the accept is given the AMC-400 Digital Transmitter will check the limits of the result and accept or reject it by displaying "Acc" or "bAd" respectively. If result has been rejected the LCD will indicate "bAd".

7) The zero calibration title "-0C" will be re-displayed for retry or exit. Push and hold and release to exit. Scroll through to the "A05" item with short presses. To begin span calibration enter the "A05" item with a push and hold >2seconds and release. The span calibration title "-SC" will be displayed.

8) At this point short press pushbutton to display the Span Gas Concentration. If the span gas concentration is to be modified then push and hold for >2seconds and release. The gas concentration can be modified one digit at a time similar to MODBUS address modification in INITIAL CONFIGURATION. Once all digits have been modified another short press will advance procedure to the gassing phase. AMC-400 Digital transmitter may ignore modification if the gas concentration entered is not acceptable.

9) **At the beginning of span calibration the AMC-400 Digital Transmitter will display "GaS" "On". Begin gassing at this point to perform a T99 type calibration. The qualified personnel can begin gassing after this point to perform a T90 type calibration by advancing the procedure to measurement phase with a press of the pushbutton.**

10) **During span gassing measurement the display will indicate either "Inc" or "dEc" depending of signal level from sensor increasing or decreasing respectively. Also the LCD will display the sensor voltage when the gas concentration is not changing. The measurement phase contains a minimum and maximum gassing period and will automatically complete after gas measurement is stable. The qualified personnel can proceed to calibration complete by pressing the pushbutton.**

11) **During span calibration complete the AMC-400 Digital Transmitter will display "GaS" "OFF". At this point the qualified personnel must accept or reject this calibration by a push and hold >2seconds or short press respectively. If the accept is given the AMC-400 Digital Transmitter will check the limits of the result and accept or reject it by displaying "Acc" or "bAd" respectively. If result has been rejected the LCD will indicate "bAd".**

12) **At this point the span calibration title "-SC" will be re-displayed for retry or exit. Push and hold >2seconds and release to exit. Scroll through to the "-CF" exit point with short presses. Push and hold >2seconds and release to exit configuration back into normal operation.**

5.3.4 GAS TEST AND SERVICE MODES

The AMC-400 Digital Transmitter should be bump tested after calibration to ensure proper sequence of operation. Gas testing under normal operation provides verification of full path operation from sensor, to monitor, to interlock. Gas testing under normal mode requires the re-application of span gas concentration as performed in gassing phase of calibration. Please refer to Appendix for menu flow diagrams and guide.

Note:

When the gas testing with low concentration gasses the AMC-400 digital transmitter may display gas concentration of 0. Consult 2.1.2 SENSOR MODULE(S) SPECIFICATION for Zero buffer gas concentration value.

The AMC-400 Digital Transmitter is equipped with two service modes:

1) **Service Mode 1: Gas testing without reporting gas concentration to monitor. This mode allows sensor sensitivity to be tested locally without alarming the rest of the building or building automation system. The gas concentration reported to monitor during this mode will be the last known level.**
2) **Service Mode 2: Forces gas concentration to monitor without actual gas testing. This mode allows the monitor alarms or building automation system to be tested without using gas.**

Note:

All service mode procedures will automatically exit to normal operation without change if left inactive for 10 minutes.

Service Mode 1:

A. To enter Service Mode 1; enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "ADR" item with short presses. To begin service mode choice enter the "ADR" item with a push and hold >2seconds and release. The service mode title "-SE" will be displayed.

B. Short press pushbutton to scroll to the "SE1" choice. Push and hold >2seconds and release to enter service mode. The Service Modes will enter a routine; displaying the gas type and concentration. With Service Mode 1 the qualified personnel can begin gassing without changing the gas concentration to monitor. The monitor will continue to receive last known gas concentration. To exit service modes wait for gas concentration to return to background levels, then push and hold >2seconds and release.

C. Short press pushbutton to scroll through items to return to "-SE" exit point. Push and hold >2seconds and release to return to "ADR" item. Again short press pushbutton to scroll through items to return to "-CF" exit point. Push and hold >2seconds and release to return to normal operation.

Service Mode 2:

A. To enter Service Mode 2; enter Configuration from normal operation mode by push and holding pushbutton for >2seconds and then releasing. The configuration title "-CF" will be displayed. Scroll through to the "ADR" item with short presses. To begin service mode choice enter the "ADR" item with a push and hold >2seconds and release. The service mode title "-SE" will be displayed.

B. Short press pushbutton to scroll to the "SE2" choice. Push and hold >2seconds and release to enter service mode. In Service Mode 2 the qualified personnel must enter a gas concentration to be forced to the monitor. Once entered the Service Modes will continuously transmit gas concentration and type to the monitor. This entry is similar to MODBUS address modification in INITIAL CONFIGURATION. To exit service modes push and hold >2seconds and release.

C. Short press pushbutton to scroll through items to return to "-SE" exit point. Push and hold >2seconds and release to return to "ADR" item. Again short press pushbutton to scroll through items to return to "-CF" exit point. Push and hold >2seconds and release to return to normal operation.

6 MAINTENANCE

Maintenance is a very important activity that should be done at the proper time intervals, which are discussed below.

6.1 GENERAL

The AMC-400 Digital Transmitter should be brushed or wiped as required, depending on the rate of accumulation of any dust or dirt.

To avoid sensor damage, the unit MUST NOT be submerged in any liquids. Hosing or splashing of the unit with any liquids must also be avoided.

6.2 SCHEDULED CALIBRATION

Scheduled calibration is critical in maintaining proper function of gas sensor/transmitters.

It is recommended that the AMC-400 Digital Transmitter be calibrated a minimum of twice a year or more often for demanding work place applications.

As mentioned, Armstrong Monitoring Corporation offers a number of different maintenance plans to suit your requirements. Please see CONTACT INFORMATION section.

6.3 SENSOR/TRANSMITTER REPLACEMENT

When its sensor signal is greatly reduced or unstable, the sensor/transmitter replacement is required; see section 2.1.2 for replacement sensor P/N.

Please note that the sensor itself is not replaceable. The Smart Sensor 2 and sensor are replaced as one assembly; please refer to 5.3.1 REQUIRED EQUIPMENT; EXCHANGE PROGRAM for instructions.

Note:

5 minutes is required for a new sensor to stabilize before calibration.

Warning:

It is possible to damage both the Smart Sensor 2 and Digital Transmitter assemblies if Smart Sensor 2 is plugged or unplugged under power. This product does not support hot powering of the Smart Sensor 2 unit. Please completely disconnect power from Digital Transmitter before replacing Smart Sensor 2 assembly.

7 APPENDIX: DIGITAL TRANSMITTER CONFIGURATION MENU FLOW

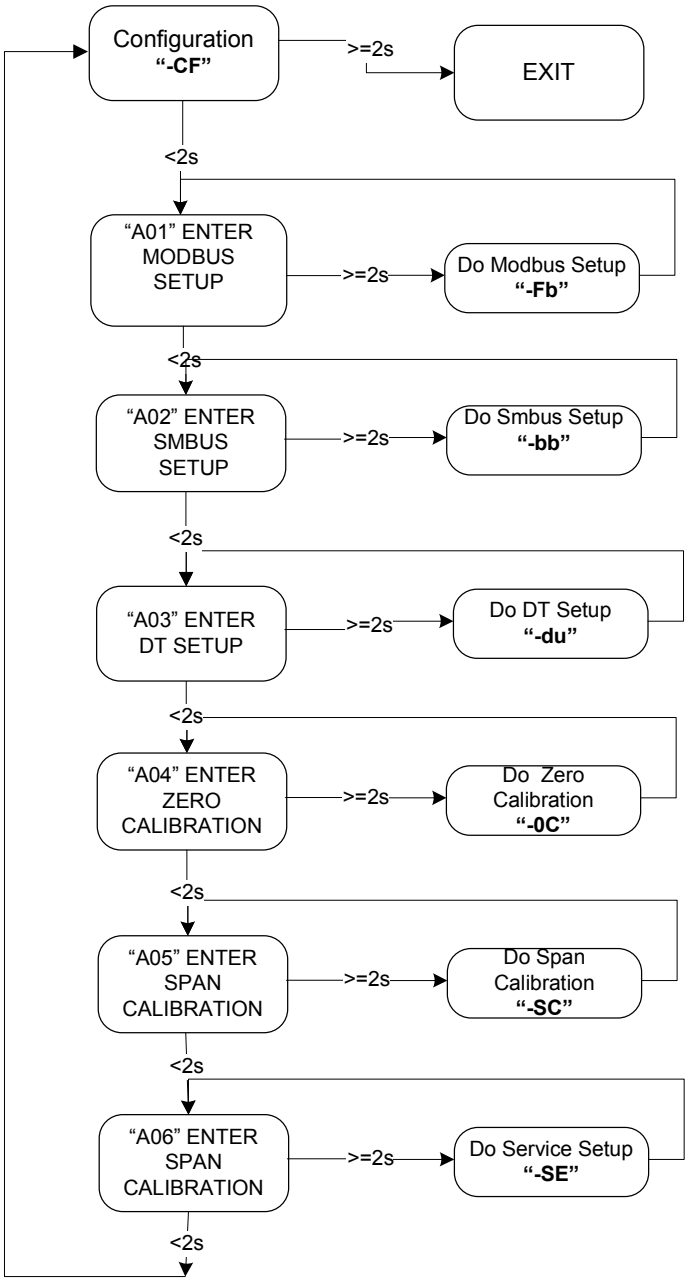
Digital Transmitter Configuration

PUSHBUTTON ACTIONS

<2 SECOND – INCREMENT OR NEXT CHOICE
>=2 SECOND – ENTER OR SELECT

DEFAULT ACTION

1 minute in any state defaults Exit Menu.

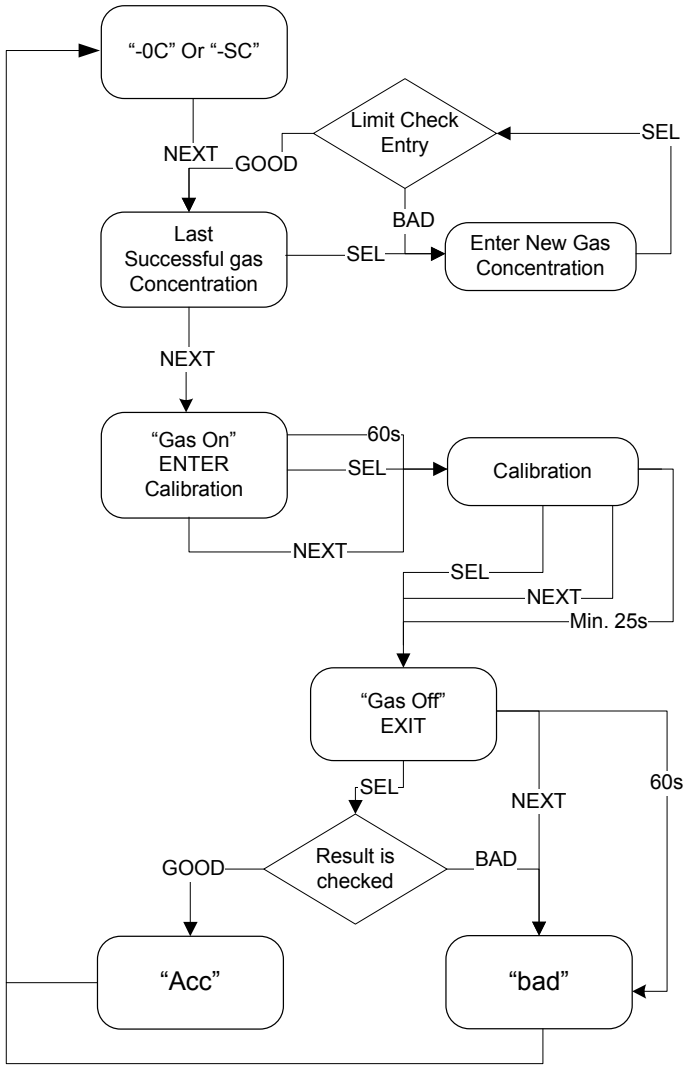


8 APPENDIX: DIGITAL TRANSMITTER CALIBRATION MENU FLOW

Digital Transmitter Zero or Span Calibration Menu

PUSHBUTTON ACTIONS
<2 SECOND = NEXT
>=2 SECOND = SEL (SELECT)

DEFAULT ACTION
1 minute in any state defaults Exit Menu.



9 APPENDIX: USER SUPPORTED MENU GUIDE

Below is the configuration menu that describes the USER supported portion of the Digital Transmitter.

< is Pushbutton input; PB is pressed, SEL is selected.

> is LCD output; ____ is a Static Display, while ____ is Blinking Display

User Interface Action	Description	*Comment*
>410	Digital Series	*2seconds*
>S0D	Software Version Revision Display (Version 0 Rev D)	*2seconds*
>.19	Software Dot Revision Display (Dot 19)	*2seconds*
>H1B	Hardware Version Revision Display (Version 1 Rev B)	*2seconds*
>____	Hardware Dot Revision Display (____)	*2seconds*
>*co or no2* >PUP >0.00	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	*Running Display*
<*SEL* >*Co or n02* >PUP >0.00	Exit Scrolling Gas Concentration Display	*Select Configuration Menus*
<*PB* >-CF	Configuration Title	*Scroll to Choices*
<*SEL* >A01	Front Bus Setup Choice	*Select Front Bus Configuration*
<*PB* >-Fb	Front Bus Title	*Scroll to Choices*
<*SEL* >F01	MODBUS Address Choice	*Select MODBUS Address Configuration*
<*SEL* >063	Default or Last MODBUS Address	*Select to edit 1st position address*
<*SEL* > 3		*Select 2nd position*
<*PB* > 6		*Change 2nd position*
<*PB* > 073		*Change 2nd position*

<PB > 083		Change 2nd position
<PB > 093		Change 2nd position
<PB > 003		Change 2nd position
<SEL >003		Select 3rd position
<SEL >003		Select finish display
<PB >003		Enter MODBUS Address
<PB >F01	MODBUS Address Setup Choice	Scroll to Choice
<SEL >-Fb	Front Bus Title	Exit Front Bus Menu
<PB >A01		Scroll to next Choice
<SEL >A02	Back Bus Setup Choice	Select Back Bus Configuration
< PB >-bb	Back Bus Title	Scroll to Choices
<SEL >b01	SMBUS Address Choice	Select SMBUS Address Configuration
<SEL >001	Default or Last SMBUS Address	Select to edit 1st position address
<SEL > 1		Select 2nd position
<SEL > 0		Select 3rd position
<SEL >0		Select finish display
<PB >001		Enter SMBUS Address
<PB >b01	SMBUS Address Choice	Scroll to Next Choice
<SEL >-bb	Back Bus Title	Exit Back Bus Menu
<PB >A02	Back Bus Setup Choice	Scroll to next Choice
<SEL >A03	DT Setup Choice	Select DT Configuration
< PB >-du	DT Title	Scroll to Choices
<PB >d01	LCD Off Mode Choice	Scroll to next Choice
<PB >d02	LCD On Mode Choice	Scroll to next Choice
<SEL >d03	Location Label Choice	Select Location Label Configuration
< SEL >LO1	Default or Last Label	Select to Change Label

<PB >__1		Modify 1st position
<PB >LO2		Modify 1st position
<SEL >LO2		Select 2nd position
<SEL >_O_		Select 3rd position
<SEL >L___		Select to finish display
<SEL >LO2	New Location Label	Scroll Label Change
<PB >d03	Location Label Choice	Scroll to Next Choice
<SEL >-du	DT Title	Exit Digital Transmitter Menu
<PB >A03	DT Setup Choice	Scroll to next Choice
<SEL >A04	ZERO Calibration Choice	Select ZERO Calibration
<PB >-OC	ZERO Calibration Title	Scroll to Enter Gas Concentration
<SEL >00.0	Default or Last Gas Concentration	Select to edit 1st position Gas
<SEL >_ .0		Select 2nd position
<PB > 0.		Change 2nd position
<SEL >01.0		Select 3rd position
<SEL >0 _.		Select finish display
<PB >01.0		Enter Gasing
>GAS>ON	Gas On Instruction	Maximum 60seconds PB or SEL to continue
>_uP	Increasing Concentration	PB or SEL to end
>dn_	Decreasing Concentration	PB or SEL to end
>1.80	Stable Concentration (signal voltage)	Monitors for 10 consecutive stable samples. Minimum 25 seconds. PB or SEL to end
>GAS >OFF	Gas Off Instruction	SEL to Accept PB or idle (Maximum 60) seconds to discard (bad)

>Acc or bad	Confirmation	*1second*
<SEL >-OCA	ZERO Calibration Title	*Exit to Zero Gas Menu*
<PB >A04	ZERO Calibration Choice	*Scroll to next Choice*
<SEL >A05	SPAN Calibration Choice	*Select SPAN Calibration*
<PB >-SC	SPAN Calibration Title	*Scroll to Enter Gas Concentration*
<SEL >100	Default or Last Gas Concentration	*Select to edit 1st position Gas*
<SEL > 0		*Select 2nd position*
<SEL > 00		*Select 2nd position*
<PB > 110		*Change 2nd position*
<PB > 120		*Change 2nd position*
<PB > 130		*Change 2nd position*
<PB > 140		*Change 2nd position*
<PB > 150		*Change 2nd position*
<SEL >150		*Select 3rd position*
<PB > 150		*Change 3rd position*
<PB > 250		*Change 3rd position*
<PB > 350		*Change 3rd position*
<PB > 450		*Change 3rd position*
<PB > 550		*Change 3rd position*
<PB > 650		*Change 3rd position*
<PB > 750		*Change 3rd position*
<PB > 850		*Change 3rd position*
<PB > 950		*Change 3rd position*
<PB > 050		*Change 3rd position*
<SEL >050		*Select finish display*
<PB >050		*Enter Gasing*
>GAS>ON	Gas On Instruction	*Maximum 60seconds* *PB or SEL to continue*
>_uP	Increasing Concentration	*PB or SEL to end*

>dn_	Decreasing Concentration	*PB or SEL to end*
>2.00	Stable Concentration (signal voltage)	*Monitors for 10 consecutive stable samples.* *Minimum 25seconds.* *PB or SEL to end*
>GAS >OFF	Gas Off Instruction	*SEL to Accept* *PB or idle (Maximum 60) seconds to discard (bad)*
>Acc or bad	Confirmation	*1second*
<SEL >-SC	SPAN Calibration Title	*Exit to Span Gas Menu*
<PB >A05	SPAN Calibration Choice	*Scroll to next Choice*
<SEL >A06	SERVICE Setup Choice	*Select SERVICE Option*
< PB >-SE	SERVICE Title	*Scroll to Choices*
<SEL >SE1	Service Mode1 Choice	*Select Service Mode2 Setup*
>co or no2 >000	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	*Running Display. Unit can be bump tested without gas concentration reflected to monitor.*
<PB or <SEL> or 10minutes	Exit Service Mode1	*Exit Service Mode*
<PB >SE1	Service Mode1 Choice	*Scroll to next Choice*
<SEL >SE2	Service Mode2 Choice	*Select Service Mode2 Setup*
<SEL >100	Default or Last Forced Gas Concentration	*Select to edit 1st position address*
<SEL > 0		*Select 2nd position*
<SEL > 0		*Select 3rd position*
<SEL >1		*Select finish display*
>co or no2 >100	Scrolling Gas Concentration Display; Displays Sensor Unit if >1 unit present, Sensor gas, Sensor Gas Concentration.	*Running Display. Unit will force gas concentration to monitor without gassing.*

<*PB* or <*SEL*> or 10minutes	Exit Service Mode2	*Exit Service Mode*
<*PB* >SE2	Service Mode2 Choice	*Scroll to next Choice*
<*SEL* >-CF	Configuration Title	*Exit to Configuration Menu*
>*co or no2* >PUP >0.00	Scrolling Gas Concentration Display	*Running Display*

10APPENDIX: MODBUS REGISTER MAP

A developer of a monitor can use the below MODBUS register map to query gas type and gas concentration from an AMC-400 series digital transmitter. A minimalistic monitor need only poll a couple of MODBUS registers to achieve the gas concentration.

- **Setup polling MODBUS address with MODBUS protocol at 9600Baud, Even Parity on EIA/TIA-485 link. Please see the FRONT LID OVERVIEW for MODBUS address. The MODBUS address can be configured from the transmitter with the user interface. Please see** INITIAL CONFIGURATION **for details.**

- **Poll Transmitter Status (Register 2)**
  - **A hex value not equal to 00xx indicate not available or not ready.**
  - **A value of 0x008F indicates transmitter is okay at 9600baud with no analog output.**

- **Read Gas Number/Node Address (Register 3)**
  - **A hex Gas Number of 00xx or 01xx represents CO or NO_2 respectively.**

- **Read Sensor Unit 32 bit Registers r28-r29**
  - **Swap 16bit values to create 32bit IEEE754 float value in PPM.**

Notes:

***1 Read. These registers can be read or written, write operation is not currently supported and will produce unpredictable results.**

***2 Not Supported. The transmitter will provide default or unspecified value.**

***3 Float. These registers are a IEEE754 decimal 32 format floating point representation when low and high 16bit registers are swapped (I.e. IEEE 754 Sensor Unit float = r29[31:16] and r28[15:0]).**

<table>
<tr><th>Data Register</th><th>MODBUS Register Index</th><th>Monitor Access</th></tr>
<tr><td>Serial Number; a 16bit number between 1-65535 exclusive to a specific AMC-400 model.</td><td>0</td><td>*1 Read</td></tr>
<tr><td>Hardware Rev / Software Rev; a 16bit number made up of four bit fields:
5 bit hardware version [15:11] (1-32 versions)
3 bit hardware revision [10:8] (A-H revisions)
5 bit software version [7:3] (1-32 versions)
3 bit software revision [2:0] (A-H revisions).
These fields are displayed on the LCD during power up.</td><td>1</td><td>*1 Read</td></tr>
<tr><td>Transmitter Status / Mode; a 16bit number made up of two 8 bit fields representing transmitter status and modes.
Instrument Status Bits[15:8]:
<table>
<tr><td>Transmitter Okay</td><td>=0x00</td></tr>
<tr><td>Transmitter Error</td><td>=0xFF</td></tr>
</table>
Instrument Mode Bits[7:0]: (Default 0x9F)
<table>
<tr><td>Reserved Self Test
0=No Self Test, 1=Self Test</td><td>Bit7</td></tr>
<tr><td>Reserved Calibration Type
0=Single Point, 1=Dual Point</td><td>Bit6</td></tr>
<tr><td>Reserved Output Enable
0=Off, 1=On</td><td>Bit5</td></tr>
<tr><td>Reserved Output Type
Not defined</td><td>Bit4</td></tr>
<tr><td>Reserved Baud Rate
0=Not Defined, 1=9600</td><td>Bit3</td></tr>
<tr><td>Reserved bit
Not Defined</td><td>Bit2</td></tr>
<tr><td>Reserved bit
Not Defined</td><td>Bit1</td></tr>
<tr><td>Reserved bit
Not Defined</td><td>Bit0</td></tr>
</table></td><td>2</td><td>*1 Read</td></tr>
</table>

Gas Number / Node Address; a 16bit number made up of two 8 bit fields of Smart Sensor 2 gas number and Transmitter MODBUS address. Gas number is updated from Smart Sensor 2 upon registration. **Gas Number [15:8]:** **CO =0** **NO2 =1** **MODBUS Address [7:0]: 1-247**	**3**	***1 Read**
Slope; a reserved 32bit float number representing the slope of the Smart Sensor 2 gas updated from Smart Sensor 2 at registration. Slope is reserved for a monitor based calibration procedure. *2 Not Supported.	**4-5**	***1 Read** ***3 Float**
Offset; a reserved 32bit float number representing the offset of the Smart Sensor 2 gas updated from Smart Sensor 2 at registration. Offset is reserved for a monitor based calibration procedure. *2 Not Supported.	**6-7**	***1 Read** ***3 Float**
Calibration Data1; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.	**8-9**	***1 Read** ***3 Float**
Calibration Data2; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.	**10-11**	***1 Read** ***3 Float**
Calibration Data3; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.	**12-13**	***1 Read** ***3 Float**
Calibration Data4; a reserved 32bit float number for a monitor based procedure. *2 Not Supported.	**14-15**	***1 Read** ***3 Float**
Output Trim Slope; a reserved 32bit float number for calibrating output slope. *2 Not Supported.	**16-17**	***1 Read** ***3 Float**
Output Trim Offset; a reserved 32bit float number for calibrating output offset. *2 Not Supported.	**18-19**	***1 Read** ***3 Float**
High Alarm; a reserved 32bit float number for Transmitter high alarm set point. *2 Not Supported.	**20-21**	***1 Read** ***3 Float**
Low Alarm; a reserved 32bit float number Transmitter low alarm set point. *2 Not Supported.	**22-23**	***1 Read** ***3 Float**
Output Span; a reserved 32bit float number for Transmitter output span. *2 Not Supported.	**24-25**	***1 Read** ***3 Float**
Output Value; a reserved 32bit float number for Transmitter output value. *2 Not Supported.	**26-27**	***1 Read** ***3 Float**

<table>
<tr><td>Sensor Unit; a 32bit float number for Smart Sensor 2 Gas Concentration. Currently in PPM.</td><td>28-29</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Sensor Output; a 32bit float number for zero based Smart Sensor 2 sensor signal voltage.</td><td>30-31</td><td>*1 Read
*3 Float</td></tr>
<tr><td>Location Label; a 1-4 character (byte) string embedded into a 32bit number used to describe the location of the transmitter. The first character of string is the most significant byte bits [31:24]. A character position value of 0x00 will terminate the string.</td><td>32-35</td><td>*1 Read</td></tr>
<tr><td>LED/MCU Status Control; a 16bit wide fault field of current transmitter state.
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>INIT_MODE</td><td>=0x0000</td></tr>
<tr><td>RUN_WITHOUT_MODBUS_MODE</td><td>=0x0001</td></tr>
<tr><td>RUN_WITH_MODBUS_MODE</td><td>=0x0002</td></tr>
<tr><td>HARD_FAULT_MODE</td><td>=0x0004</td></tr>
<tr><td>SOFT_FAULT_MODE</td><td>=0x0008</td></tr>
<tr><td>CONFIGURATION_MODE</td><td>=0x0010</td></tr>
<tr><td>TEST_MODE</td><td>=0x0020</td></tr>
</table></td><td>36</td><td>*1 Read</td></tr>
<tr><td>DT Fault; a 16bit wide fault field recorded of all high level transmitter faults. Fault bit(s) are set under fault condition along with appropriate fault register. See appropriated fault register bits for details.
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>DT_NO_FAULT</td><td>=0x0000</td></tr>
<tr><td>SST_FAULT</td><td>=0x0001</td></tr>
<tr><td>A2D_FAULT</td><td>=0x0002</td></tr>
<tr><td>I2C_FAULT</td><td>=0x0004</td></tr>
<tr><td>SMB_FAULT</td><td>=0x0008</td></tr>
<tr><td>MOD_FAULT</td><td>=0x0010</td></tr>
<tr><td>LCD_FAULT</td><td>=0x0020</td></tr>
<tr><td>LED_FAULT</td><td>=0x0040</td></tr>
<tr><td>PB_FAULT</td><td>=0x0080</td></tr>
<tr><td>TIM_FAULT</td><td>=0x0100</td></tr>
<tr><td>SS2_FAULT</td><td>=0x0200</td></tr>
<tr><td>REG_FAULT</td><td>=0x0400</td></tr>
</table></td><td>37</td><td>*1 Read</td></tr>
</table>

SST Fault (System Self Test); a 16bit wide fault field of transmitter's system self testing. Fault bit(s) are set under fault condition during power up and runtime operation.

Enumeration Name	Field Enumeration
SST_NO_FAULT	=0x0000
SST_BROWN_OUT	=0x0001
SST_WATCHDOG	=0x0002
SST_LOW_VOLT	=0x0004
SST_ILL_CODE	=0x0008
SST_PIN_RESET	=0x0010
SST_TEST_REBOOT	=0x0020
SST_MOD_LOCKUP_REBOOT	=0x0040
SST_SMB_LOCKUP_REBOOT	=0x0080

38 | *1 Read

A2D Fault (Analog To Digital Subsystem); a 16bit wide fault field of transmitter's A2D subsystem, internal temperature device and DC input voltage monitoring.

Enumeration Name	Field Enumeration
A2D_NO_FAULT	=0x0000
A2D_TIMEOUT_FAULT	=0x0001
A2D_HIGH_TEMPERATURE_FAULT	=0x0002
A2D_LOW_TEMPERATURE_FAULT	=0x0004
A2D_HIGH_VOLTAGE_FAULT	=0x0008
A2D_LOW_VOLTAGE_FAULT	=0x0010

39 | *1 Read

I2C Fault (Inter-Intergrated Circuit Subsystem); a 16bit wide fault field of transmitter's I2C subsystem and attached EEPROM device.

Enumeration Name	Field Enumeration
I2C_NO_FAULT	=0x0000
I2C_TIMEOUT_FAULT	=0x0001
I2C_HARD_FAULT	=0x0002
I2C_RXAK_FAULT	=0x0004
I2C_OPEN_WRITE	=0x0008
I2C_BAD_UPGRADE	=0x0010
I2C_NEW_FIRMWARE	=0x0020

40 | *1 Read

SMB Fault (SS2 Communication Bus); a 16bit wide fault field of transmitter's SMB subsystem. — **41** — ***1 Read**

Enumeration Name	Field Enumeration
SMB_NO_FAULT	=0x0000
SMB_CE_FAULT	=0x0001
SMB_OVRR_FAULT	=0x0002
SMB_MSG_FAULT	=0x0004
SMB_CRC_FAULT	=0x0008
SMB_SCI1_FAULT	=0x0010
SMB_RETRY_FAULT	=0x0020
SMB_TOO_MANY_IDS	=0x0040
SMB_NO_SMB_ONLINE	=0x0080
SMB_OVRF_FAULT	=0x0100
SMB_RMSG_FAULT	=0x0200
SMB_PMSG_FAULT	=0x0400
SMB_IDMSG_FAULT	=0x0800
SMB_DMSG_FAULT	=0x1000

MODBUS Fault (MODBUS Subsystem); a 16bit wide fault field of transmitter's MODBUS subsystem. — **42** — ***1 Read**

Enumeration Name	Field Enumeration
MOD_NO_FAULT	=0x0000
MOD_CE_FAULT	=0x0001
MOD_OVRR_FAULT	=0x0002
MOD_MSG_FAULT	=0x0004
MOD_CRC_FAULT	=0x0008
MOD_SCI2_FAULT	=0x0010
MOD_DECODE_FAULT	=0x0020

LCD Fault (LCD Subsystem a 16bit wide fault field of transmitter's LCD subsystem. — **43** — ***1 Read**

Enumeration Name	Field Enumeration
LCD_NO_FAULT	=0x0000

LED Fault (LED Subsystem); a 16bit wide fault field of transmitter's LED subsystem. — **44** — ***1 Read**

Enumeration Name	Field Enumeration
LED_NO_FAULT	=0x0000

PB Fault (PushButton Subsystem); a 16bit wide fault field of transmitter's Pushbutton subsystem. — **45** — ***1 Read**

Enumeration Name	Field Enumeration
PB_NO_FAULT	=0x0000

<table>
<tr><td>TIM Fault (Timer Subsystem); a 16bit wide fault field of transmitter's Timer subsystem.
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>TIM_NO_FAULT</td><td>=0x0000</td></tr>
<tr><td>TIM_LATENCY_FAULT</td><td>=0x0001</td></tr>
</table></td><td>46</td><td>*1 Read</td></tr>
<tr><td>SS2 Fault (Smart Sensor 2 Subsystem); a 16bit wide fault field of transmitter's Smart Sensor 2 subsystem.
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>SS2_NO_FAULT</td><td>=0x0000</td></tr>
<tr><td>SS2_CONV_OVRF_FAULT</td><td>=0x0001</td></tr>
<tr><td>SS2_SPAN_GAS_FAULT</td><td>=0x0002</td></tr>
<tr><td>SS2_RAW_A2D_CAL_FAULT</td><td>=0x0004</td></tr>
<tr><td>SS2_SENSOR_UNSTABLE_FAULT</td><td>=0x0008</td></tr>
<tr><td>SS2_ZERO_CAL_FAULT</td><td>=0x0010</td></tr>
<tr><td>SS2_USER_CAL_ABORT</td><td>=0x0020</td></tr>
</table></td><td>47</td><td>*1 Read</td></tr>
<tr><td>Reg Fault (Register Map Subsystem); a 16bit wide fault field of transmitter's Register Map subsystem.
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>REG_NO_FAULT</td><td>=0x0000</td></tr>
</table></td><td>48</td><td>*1 Read</td></tr>
<tr><td>Peak_MODBUS_Flag; a 16bit number representing the measured peak MODBUS traffic in characters per seconds.</td><td>49</td><td>*1 Read</td></tr>
<tr><td>Peak_SMBUS_Flag; a 16bit number representing the measured peak SMBUS traffic in characters per seconds.</td><td>50</td><td>*1 Read</td></tr>
<tr><td>Systicks; a 32bit number representing the number 10msec system ticks that has elapsed on the current powered up day.</td><td>51-52</td><td>*1 Read</td></tr>
<tr><td>Days; a 16bit number of the days powered up.</td><td>53</td><td>*1 Read</td></tr>
<tr><td>DT_Vin_A2D; a 14bit A2D number from 0x0-0x3FFF representing the DC input voltage of 0-55volts.</td><td>54</td><td>*1 Read</td></tr>
<tr><td>DT_10x_Vin; a 32bit float number representing the 10 times DC input voltage.</td><td>55-56</td><td>*1 Read
*3 Float</td></tr>
<tr><td>DT_Temperatue_A2D; a 14bit A2D number of the internal processor thermometer peripheral.</td><td>57</td><td>*1 Read</td></tr>
<tr><td>DT_10x_Temperature; a 32bit float number representing the 10 times transmitter's temperature in Celsius.</td><td>58-59</td><td>*1 Read
*3 Float</td></tr>
</table>

<table>
<tr><td>DT_BandGap A2D; a 14bit A2D number from the internal processor bandgap device. The bandgap device is used to measure the processor's internal A2D voltage rail.</td><td>60</td><td>*1 Read</td></tr>
<tr><td>DT_10x_VDD; a 32bit float number representing the 10 times transmitter's processor internal A2D voltage rail.</td><td>61-62</td><td>*1 Read
*3 Float</td></tr>
<tr><td>DT_Cfg_type; a 16bit field indicating transmitter's configuration for items like; MODBUS Baud Rate, MODBUS Parity, LCD blanking, access and normal powered day period.
MODBUS Baud Rate bits[3:0]:
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>MODB9600</td><td>=0 (Default)</td></tr>
<tr><td>MODB19200</td><td>=1 (Not Supported)</td></tr>
<tr><td>MODB38400</td><td>=2 (Not Supported)</td></tr>
<tr><td>MODB115200</td><td>=3 (Not Supported)</td></tr>
</table>
MODBUS Parity mutually exclusive bit[5:4]:
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>MODNOPARITY</td><td>=0 (Not Supported)</td></tr>
<tr><td>MODODDPARITY</td><td>=1 (Not Supported)</td></tr>
<tr><td>MODEVENPARITY</td><td>=2 (Default)</td></tr>
</table>
LCD Blanking bit[6]:
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>DTLCDOFF</td><td>=0 (LCD will blank)</td></tr>
<tr><td>DTLCDON</td><td>=1 (Default)</td></tr>
</table>
Access Bit[7]:
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>DTACCOFF</td><td>=0 (Not Supported)</td></tr>
<tr><td>DTACCON</td><td>=1 (Default)</td></tr>
</table>
Normal Power Day Period Bit[8]:
<table>
<tr><th>Enumeration Name</th><th>Field Enumeration</th></tr>
<tr><td>DTNORMDAYOFF</td><td>=0 (Fast Day) days advance every 14.40 minutes.</td></tr>
<tr><td>DTNORMDAYON</td><td>=1 (Default) days advance every 1440 minutes.</td></tr>
</table>
</td><td>63</td><td>*1 Read</td></tr>
</table>